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ABSTRACT

This paper offers a concise 3-page summary of the results of some investigations of sucking behavior during the neonatal period. This is followed by a page of references and 16 pages of pertinent diagrams and their descriptions. The investigations are the result of an objective technique developed for measuring the nutritive sucking behavior of the newborn. (JF)

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Studies of Sucking Behavior in the Human Newborn: The Diagnostic and Predictive Value of Measures of Earliest Oral Behavior

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A variety of experimental and clinical findings in animals and man emphasize the relation of early behavioral characteristics to later psychological development. To study the relationship between infant and adult characteristics it is necessary to have reliable methods for measuring behavior--however, there are few precise methods applicable to the newborn. The investigator has developed a reliable technique (1) for recording nutritive sucking which permits the objective measurement of infant behavior as early as the first day of life (Figures 1 and 2). This paper describes some of the results from our investigations of sucking behavior during the neonatal period.

In our initial studies consistent individual differences (2, 3) between infants in sucking patterns (Figures 3A, 3B, 4A and 4B) was the most prominent finding. However, some infants evidenced unexplained irregularities of the sucking response. The clinical data indicate that the disorganization observed in sucking activities may be related to brain dysfunction. For example, the author studied the sucking behavior of a set of fraternal twins (Figures 3A, 3B, 5A and 5B). Twin A had a normal spontaneous delivery, while Twin B experienced distress in utero and underwent a traumatic forceps delivery. The Apgar score (4) of Twin B was very low--the infant was apneic, cyanotic and flaccid at the time of delivery; however,

he was quickly resuscitated. The attending pediatrician suspected brain injury but there were no gross clinical findings of such, the infant was considered apparently normal at 24 hours of age. The sucking records of this infant at 24 hours of age (Figure 5B) evidenced an initial period of disorganized sucking before its characteristic pattern was instituted (Figure 3B). At 48 and 72 hours, and even at 6 weeks of age, the possibly damaged infant continued to evidence disorganization of sucking. This irregularity of sucking behavior at the onset of feeding may be related to the spasticity of motor function found in older children with CNS damage (cerebral palsy).

Currently there is no reliable clinical method for diagnosing brain defects or injuries at birth except in the severely damaged infant--over 50% go undetected. Neurological symptoms of mild brain dysfunction do not become manifest until the second year of life, and intellectual deficits may appear even later. Therefore, it has not been possible to diagnose most brain disorders within the newborn period nor to identify the specific perinatal causes. Measures of infant sucking behavior may facilitate the early diagnosis of brain dysfunction, and lead to a better understanding of the casual factors in brain disorders such as cerebral palsy and mental retardation.

A variety of perinatal factors are known to adversely affect the newborn. For example, pediatricians found that the high concentration of oxygen formerly used in the premature nursery was the principle cause of induced blindness during infancy (retrolental fibroplasia); also, large doses of medication administered to the mother to ease the pain of labor and child-

birth may pass across the placenta and adversely affect the vital functions of the newborn. In our studies (1, 3, 5) we found that even "routine" amounts of maternal sedation exert a prolonged and powerful depressant effect upon the infants' feeding behavior (Figures 6 and 7). The sucking instrument may prove to be a sensitive tool for evaluating the noxious effects of various perinatal influences upon the newborn.

There is no valid method for measuring the intellectual capacity of a child before 2-1/2 years of age at which time standard I.Q. tests, e.g. Stanford-Binet (6), become applicable. Infant developmental testing, e.g. Gesell Schedules (7), provides information about the child's sensorimotor and social progress; however, intelligence (adaptability, problem solving, etc.) is not reliably measured. In our studies (8, 9) we found differences between newborns in their ability to adapt to intermittent schedules of nutrient reinforcement (Figures 8, 9A and 9B0. Such individual differences in neonatal adaptability may reflect learning capacity, have value as a test for brain dysfunction, and predict intellectual ability at subsequent stages of development. The technique also tests the adequacy of the infant's perceptual and response apparatus and thereby permits early diagnosis of defects in hearing, vision, and in the other sensory modalities.

Summary

An objective technique has been developed for measuring the nutritive sucking behavior of the newborn. This method has revealed distinctive patterns of sucking activity as early as the first day of life, and has permitted

the measurement of environmental and physiological effects upon sucking behavior. In our studies we also found differences between newborns in adaptation to schedules of intermittent reinforcement. These individual variations may have value as predictors of later behavior. The sucking instrument appears to have special application to the study of developmental changes in CNS functioning during normal and pathological states within infancy, and may provide a means for the early diagnosis of disturbances in brain functioning and help to define the perinatal causes of brain disorders.

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Legend

Figure 1. A newborn infant participating in a study of feeding behavior.

Figure 2. Diagram of instrument for recording nutritive sucking behavior.

Figure 3A. Behavioral individuality in a set of fraternal twins. Twin A. Sample of record from test feeding administered 24 hours postnatal. Sucking pattern characterized by "long" bursts of approximately 30 sucks each.

Figure 3B. Twin B. Sample of record from test feeding administered 24 hours postnatal. Sucking pattern characterized by "medium" bursts of approximately 15 sucks each.

Figure 4A. Consistency of behavioral individuality during the first days of life. Infant C. Sample of record from test feeding administered 24 hours postnatal. Sucking pattern characterized by "short" bursts of approximately 4 sucks each.

Figure 4B. Infant C. Sample of record from test feeding administered 48 hours postnatal. Note persistence of characteristic sucking pattern between repeated daily tasks.

Figure 5A. Differences in organization of sucking behavior of fraternal twins at the onset of the test feeding. Twin A. Organized sucking is initiated immediately after the nipple is introduced into the mouth.

Figure 5B. Twin B. There is an initial period of disorganized sucking activity immediately after the nipple is introduced.

Figure 6. Sample recordings obtained with the sucking instrument. Note that infants differ in individual measures of sucking behavior (e.g. rate, pressure); however, the average measures obtained from groups of infants are consistent from group to group when tested under the same experimental conditions. Therefore the influence upon infant behavior of perinatal factors (e.g. maternal sedation) can be studied by comparing the feeding responses of matched groups of infants that differ only the factor under study.

Figure 7. Effects of obstetric sedation. Differences in sucking behavior between matched groups of newborn infants within the first week of life. The infants were studied at 24, 48, and 72 hours of age (Trials 1, 2 and 3). The data illustrate that the rate of nutritive sucking is significantly affected by drugs administered to the mother during labor and delivery. The experimental group was born of mothers who received a single dose of sedation during labor, while the control group was delivered of mothers who received no sedation. The prolonged depressant effects upon the newborn may interfere with the adjustment of the infant to the nursing situation and with other adaptive functions.

Figure 8. Diagram of instrument to provide intermittent schedules of nutrient reinforcement. The instrument is programmed to open and close the solenoid valve, and to give an auditory signal at times when nutrient is available. Approximately 10% of neonates adapt their sucking behavior to the program of

intermittent reinforcement during the first week of life.

Figure 9A. Infant D. First few minutes of adaptation to an intermittent schedule of reinforcement in a 24-hour-old infant. The marker pen (heavy interrupted line) indicates the simultaneous availability of nutrient and the sounding of a signal buzzer. Note initial lack of coordination between sucking and reinforcement.

Figure 9B. Infant D. Fifth and sixth minutes of the above record showing the development of coordination between the infant's sucking activity, and the intermittent auditory signal and nutrient reinforcement. This type of adaptive behavior indicates functioning of the infant's perceptual and response apparatus, and may reflect the learning capacity of the newborn.

Acknowledgments

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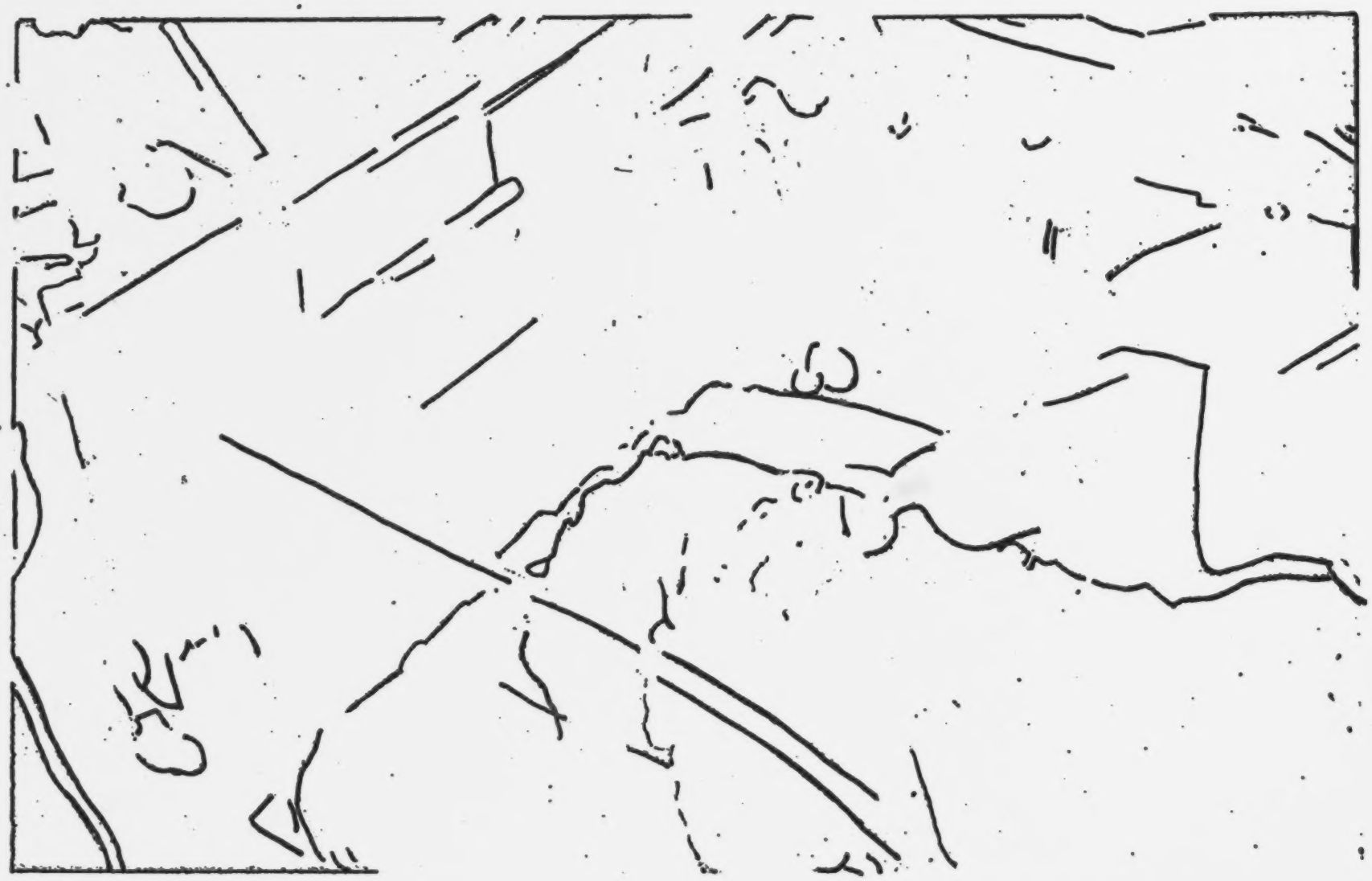

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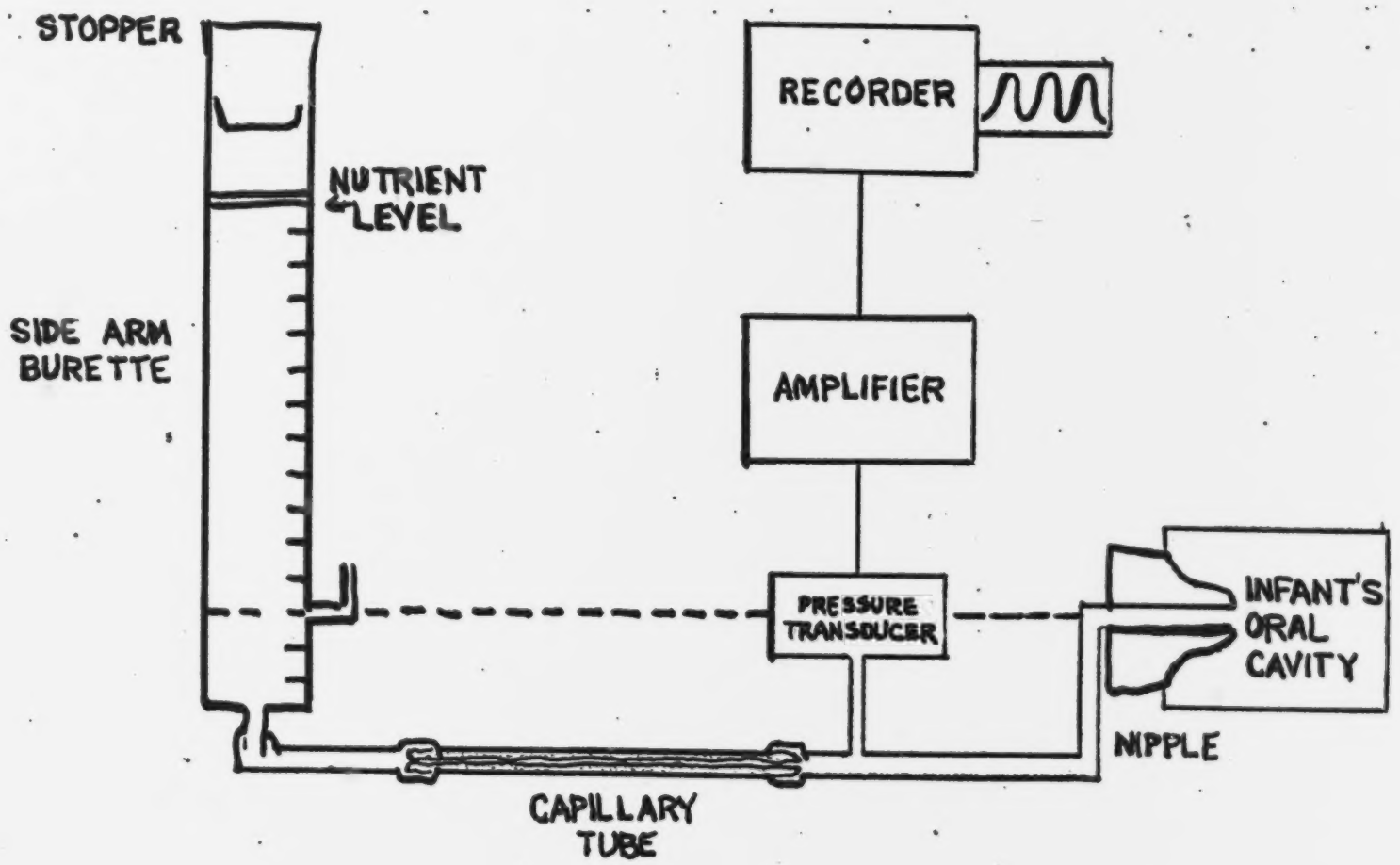

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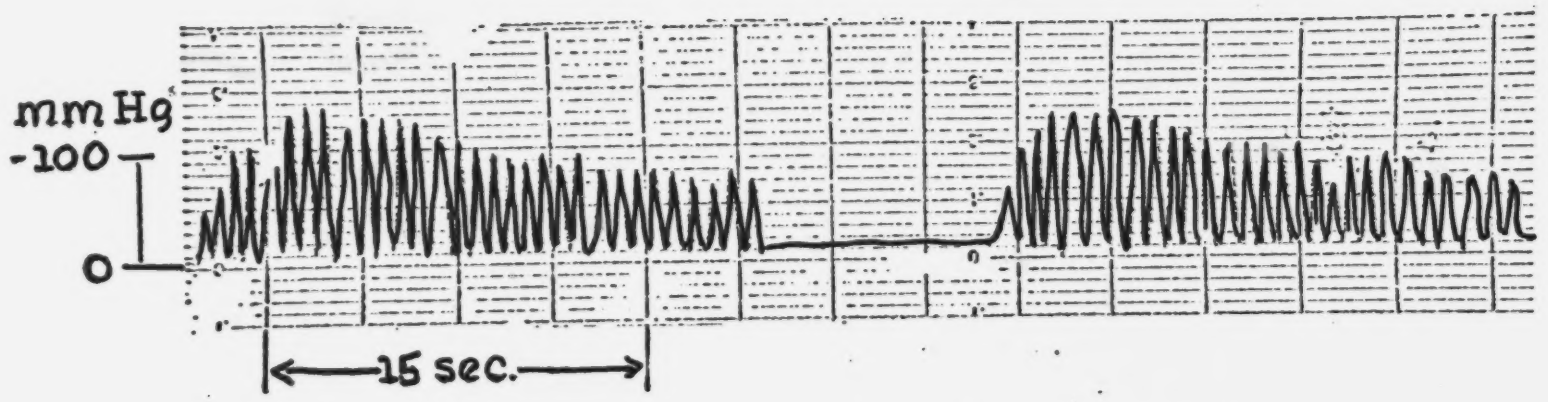

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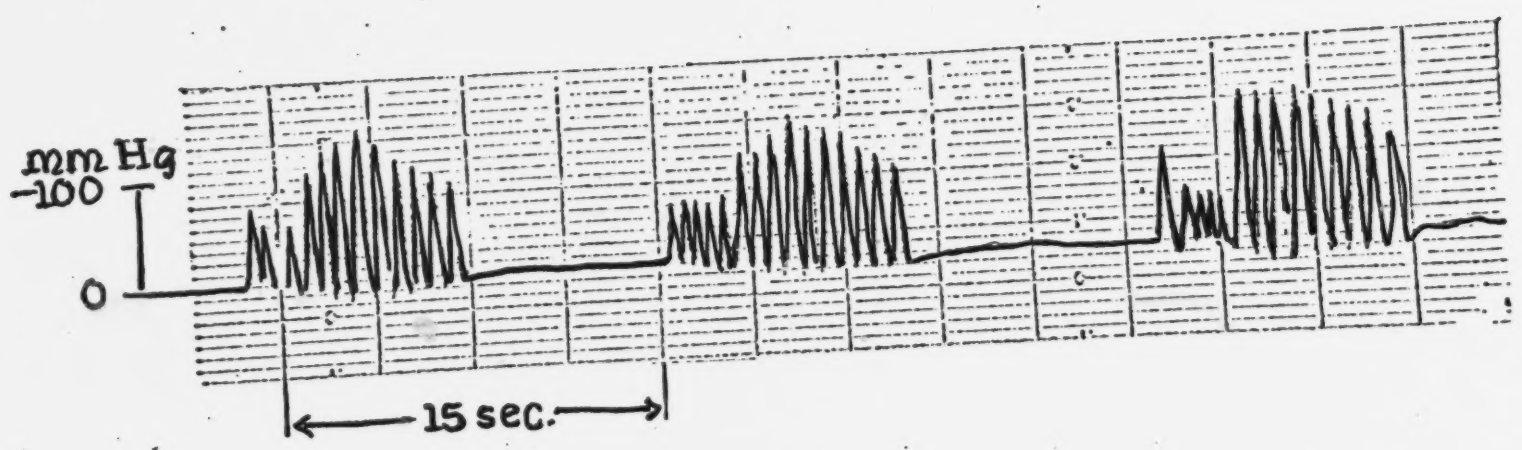

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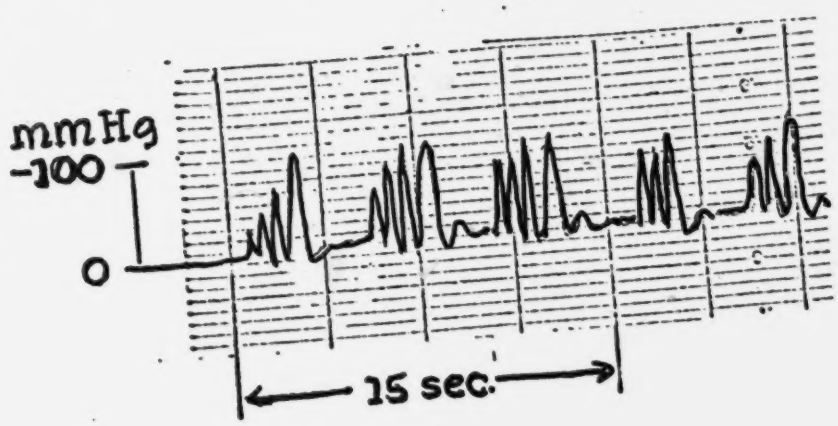

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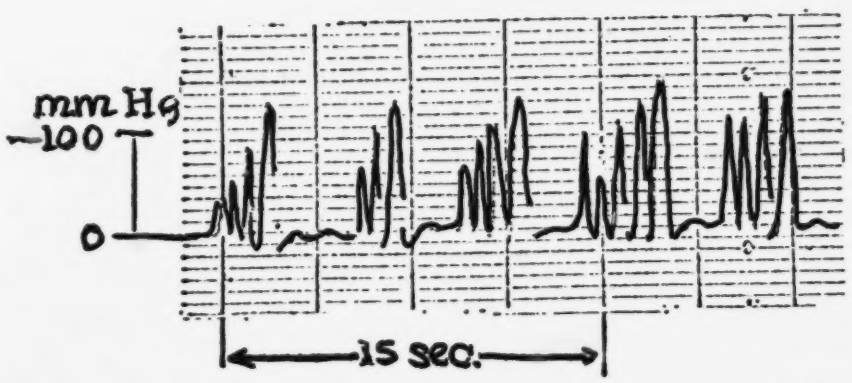

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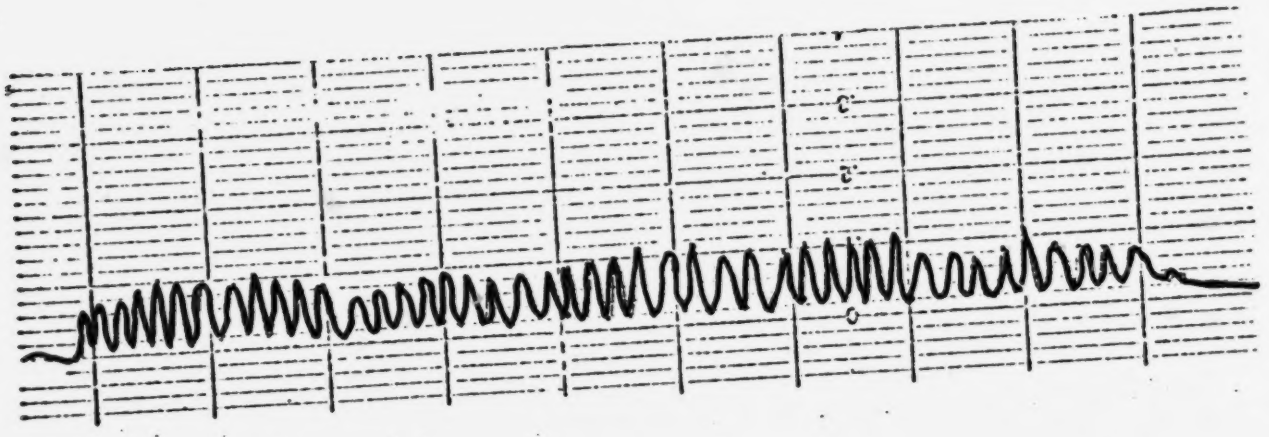

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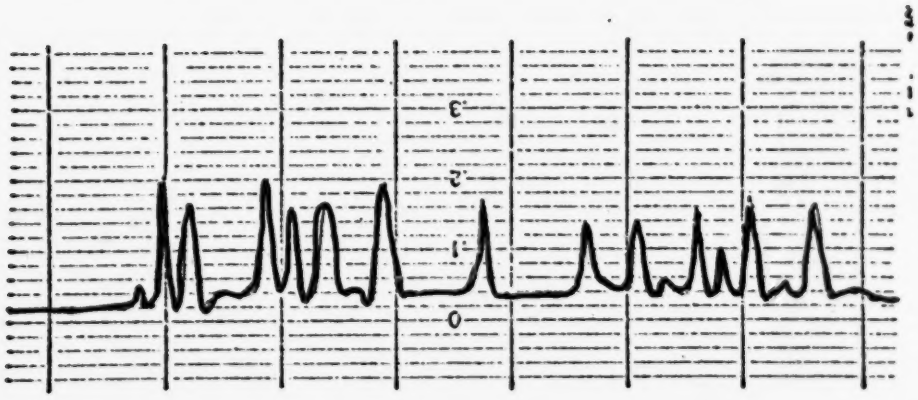

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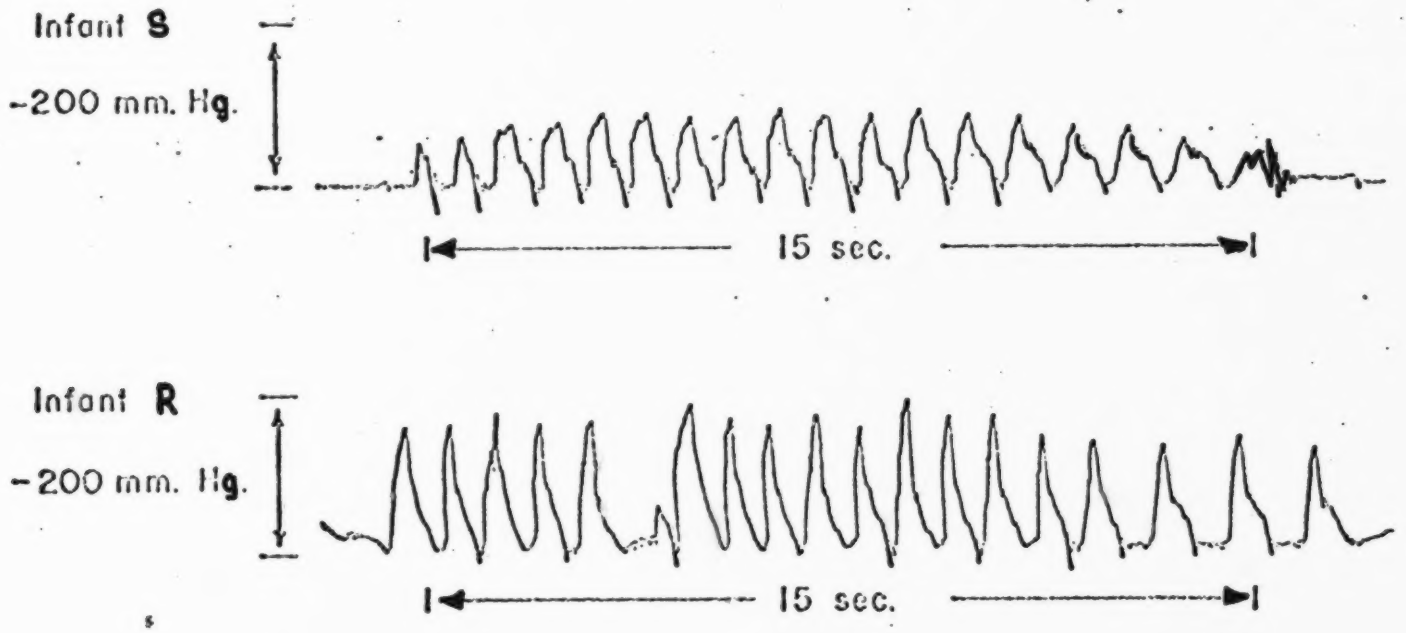

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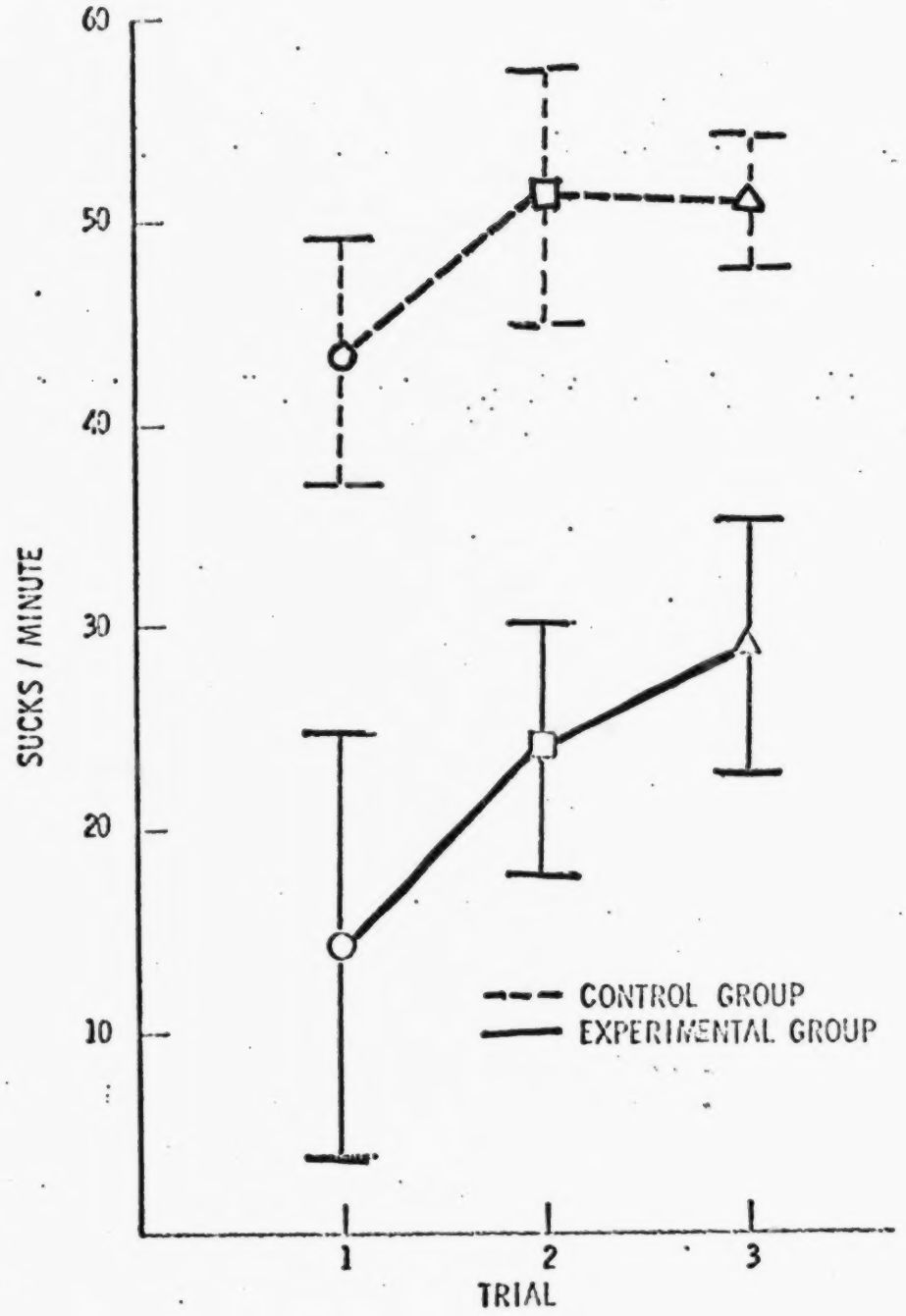

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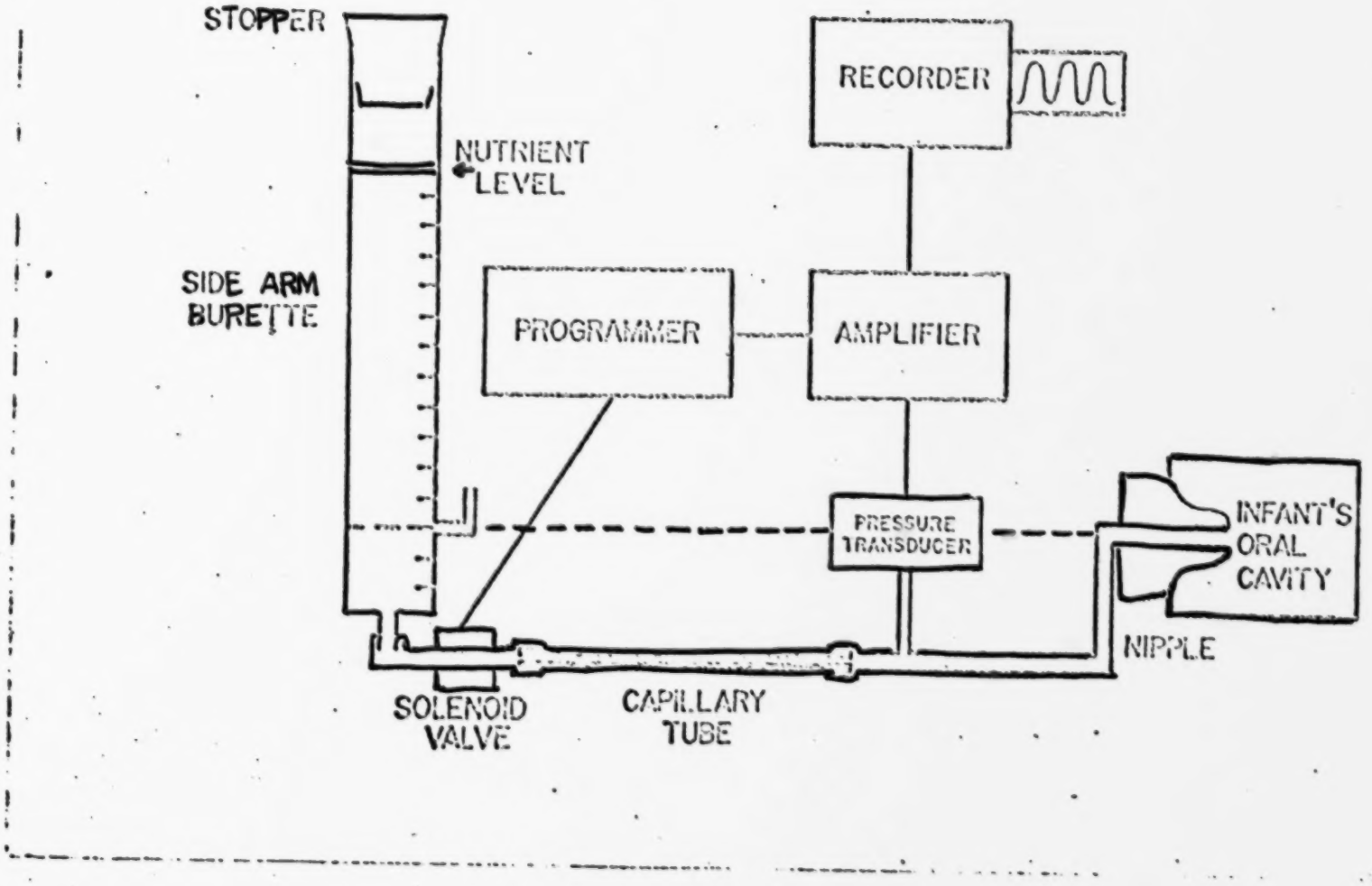

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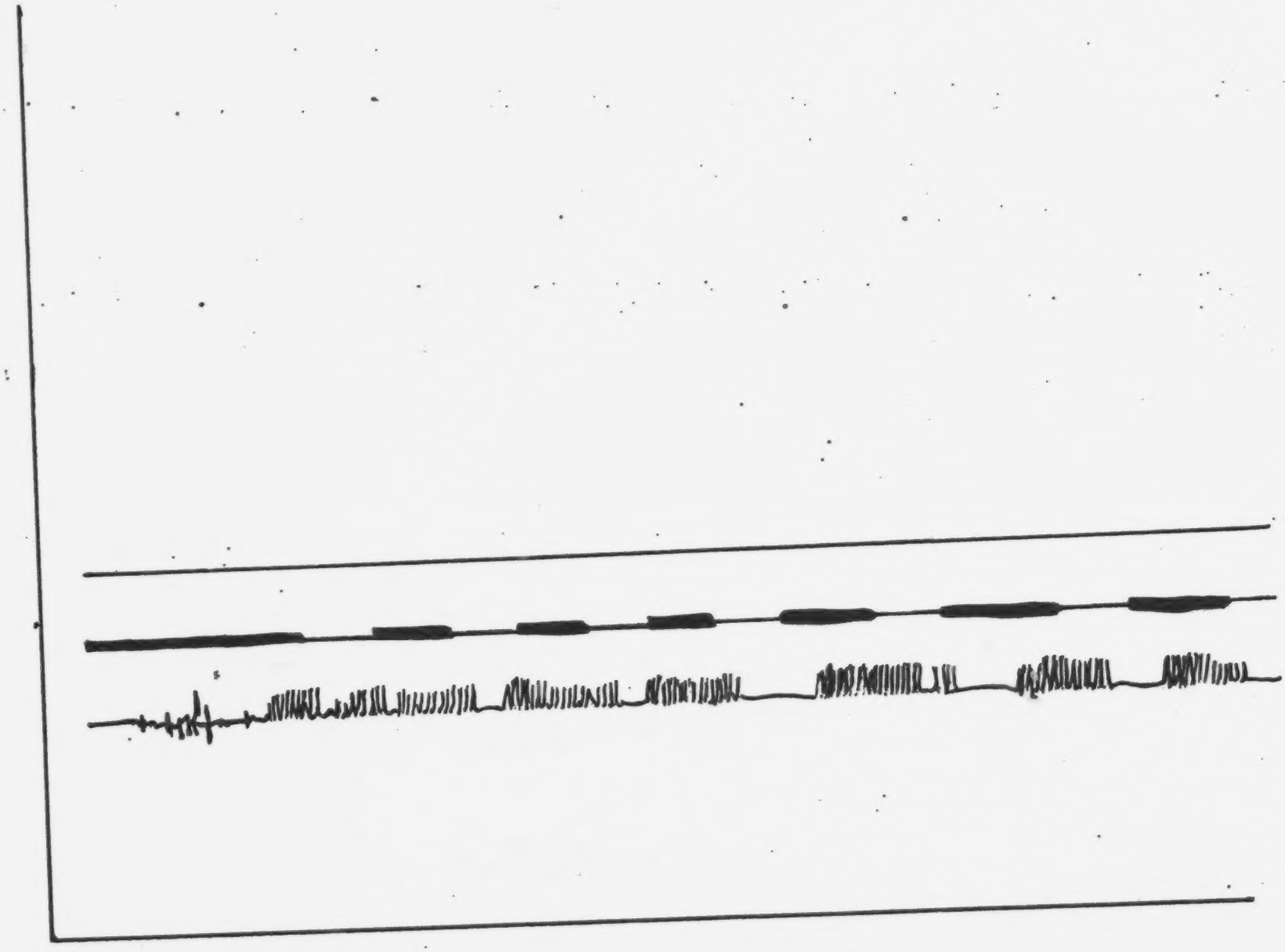

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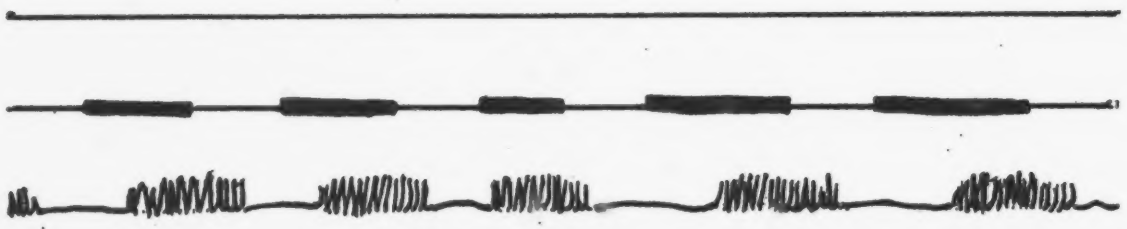

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